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(54) Method and equipment with high productivity for the sorting of parcels

(57) Describes a method for the sorting of objects by means of an equipment consisting in a plurality of conveyor platforms running along a route between an objects loading zone and an unloading zone in which the objects are unloaded into collecting devices situated sideways with respect to the route of the conveyor platforms and in which each of said conveyor platforms is fitted with means for unloading the conveyed objects sideways with respect to the machine, comprising the following steps:

- the objects to be sorted are ordered in pairs so as to load them in the machine respecting the unloading order;
- two objects are loaded on each conveyor platform;
- the unloading of said objects is carried out according to the required order, when said conveyor platform runs near of the collecting devices designed for said objects.

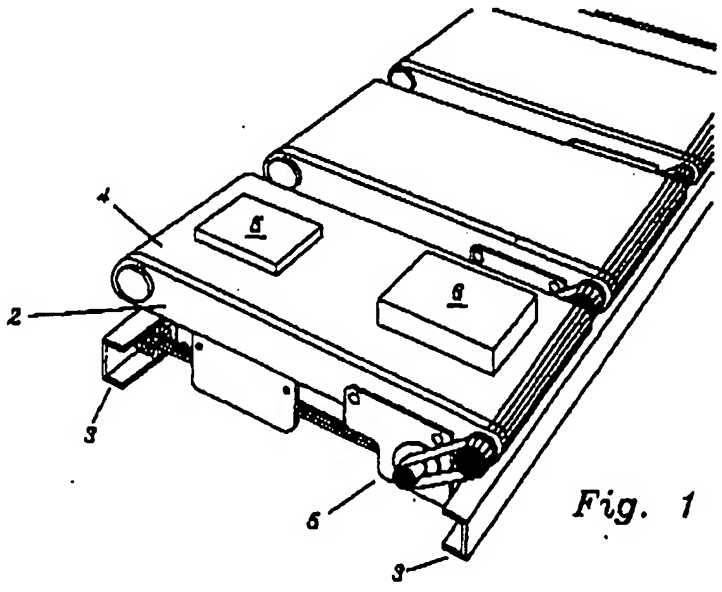

Fig. 1

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Description

[0001] The present invention proposes a method and an equipment for the automatic sorting of objects, which with respect to the existing machines permits substantially t double the productivity..

[0002] In particular, the method according to the invention is designed for the conveyance of objects in pairs on single sorting units of the sorting machine, formed by conveyor belts, by loading two different objects on each conveyor belt and sorting them in sequence at their respective destinations.

[0003] The sorting equipment according to the invention is formed by a series of trucks moving along a closed circuit along which containers are arranged which correspond to the different sorting destinations.

[0004] Each truck, according to a technic known as "cross belt" is fitted with a conveyor belt which can be activated to move perpendicularly to the running direction of the truck, so that the objects could be unloaded to the destinations placed at both sides of the sorting machine.

[0005] The invention makes possible, as it will be shown after in details, to double the production capacity of the sorting machines existing nowadays, combining the favourable characteristics of a sorting unit provided with belts, able to perform repeated controlled shiftings in the two senses, with the observation that, with two objects to be sorted it is always possible to establish the order in which arrange the same on the same sorting unit, so that they could be sorted to the destination with successive activations of the belt.

[0006] Before describing in details the invention, it is convenient to check the limits of productivity of the actual sorting machines and the reason why the search of new sorting machines capable of a higher productivity could be justified.

[0007] The sorting machines capable of the most higher productivities, are basically divided intro three types, depending on the solutions adopted for the unloading of the objects to the destination.

[0008] With tilt trays: the conveyor unit, usually a tray in a material with low friction mounted on a truck, is turned over in correspondence of the destination so that the object on board is accelerated laterally by the gravity force reaching then the destination.

[0009] With shoe sorters: the succession of conveyor units, dragged by chains forms a conveyor belt; each conveyor unit comprises a shoe sorter element which can be controlled to move through the conveyor platform in a direction orthogonal to the advancing direction of the machine, to push the object to the destination.

[0010] Usually these equipments are fitted with conveyor units very short so that it is possible to give to each object to be sorted a number of shoe sorters suitable to its lenght, a very useful solution to optimize the productivity when objects having different dimensions are to be sorted.

[0011] With cross belts: the sorting machine is formed by a series of trucks fitted with conveyor belts, the conveyor and sorting elements, oriented perpendicularly with respect to the direction of the sorting machine, which are actuated for the unloading in order to direct the object towards the collecting means at the sides of the route.

[0012] These latest equipments reached considerable levels of sophistication since the belt unloading has very precise contol functions. Sorting machines are known, in which each object is measured, in order to be loaded exactly in the middle of the cell, its correct positioning is checked, controlling, when necessary, the movement of the belt to correct the centring.

[0013] When unloading, the control actuates the belt with leads and acceleration ramps which are a function of the advancing speed, of the position on the cell, of the dimension, sometimes the kind, of the object, in order to assure the greatest unloading precision also with the most different objects.

[0014] These equipments are described, for example, in the patents EP 0.481.341, EP 0.518.180 and EP 0.656.868, to which reference is made for more details.

[0015] All the equipments known have a limit of productivity, that is the number of objects the machine is capable of sorting in a time interval, determined essentially by the fact that the advancing speed of the machine must be lower, in the greatest part of the plants, than 2m/sec.

[0016] At this speed, a sorting machine comprising, for example a continuous succession of cells having a pitch of 500 mm, will drive before an utilizer 14400 cells per hour, than will sort as many objects per hour, provided that any cell is capable of receiving and sorting an object during any revolution of the machine.

[0017] For little objects to be sorted (dresses, books, envelopes, little parcels) the value above mentioned represents practically the actual technological limit.

[0018] More elevated speeds of the sorting machine would involve longer transients of accelleration during the loading with greater problems of precision due to the sliding and rolling effects of the objects.

[0019] Furthermore speeds near to 2 m/sec may cause effects that compromise the reliability of the treatment of light objects, due to the braking action of the air resistance, these effects getting rapidly worse with the increasing of the speed.

[0020] The productivity limits of the existing sorting technics are very often penalized with respect to the application requirements: in the different sectors the concentration of the distributive function in few centers requires, more often solutions for the automatic sorting of fluxes higher than those permitted by a sorting machine, towards an elevated number of destinations.

[0021] In order to satisfy these requirements numerous solutions have been realized using the available machines, but, with results not very satisfying because of the complexity and of the high prices.

[0022] In order to double the productivity a first solution consists in the use of two sorting machines moving along parallel routes and unloading the objects towards common exits. (It is the case, for example of two superposed sorting machines).

[0023] The solution is however very expensive because it requires two complete machines, more spaces, and also because the sorting towards common exits creates new complexities, for example the necessity of introducing conveyor belts and controls to the destination in order to drive in the same, with order and without crashes, the objects sorted in the same time by the two machines.

[0024] Therefore, this solution can result suitable only in the case of applications with high productivity and a low number of destinations.

[0025] Another technic, largely used when the applications involve a high number of destinations and a productivity higher than that of a single sorting machine, consists in the use of the so-called "presorting".

[0026] This technic involves the use of two machines in parallel and the division of the number of exits between these two machines. Substantially one of the machines will unload in the first half of the exits and the other in the second half.

[0027] In practice, it is necessary to divide the objects to be sorted towards two principal directions, each one having half of the final destinations of the sorting.

[0028] Since downstream the presorting station two sorting machines are used, each one with half of the total number of destinations, it will be possible to obtain the required productivity provided that the two fluxes of the pre-sorted objects are maintained constantly equal.

[0029] This condition is in reality very onerous and involves many complexities and costs both for dividing the entring objects, and for realizing suitable accumulations of objects presorted so that to reduce unbalancements between the two fluxes directed towards the sorting machines.

[0030] Even if it can be assumed that the destinations of the two groups are equiprobable, during the presorting on the short period the object are not divided exactely between the two directions, casually.

[0031] Without suitable dynamic accumulations these unbalancements would constantly produce loss of productivity because a machine, saturated, would slow the flux in entrance, while the other would have a not completely used production capacity.

[0032] Therefore it is possible to understand that the very expensive costs, the great complexity and also the exposure, heavy effects of casuality.

[0033] Now the present innovation proposes a method and the relating equipment for the sorting of the parcels which permits a more simple solution to the problem to the elevated productivity.

[0034] The machine proposed is a sorting machine with orthogonal belts, with sorting units dimensioned in such a way that on board of each belt two objects can be loaded, instead of one, as in the existing sorting machines.

[0035] Th objects are loaded on the belt by two successive activations, ordered when loaded so that it can be possible to sort them to their respective destinations by means of successive activations of the b lt.

[0036] In order to do this, i.e. in order to be able to use the one and only possibility offered by the belt, as a sorting unit of multiple objects, it is sufficient, if we have two objects whose destinations are known, to establish the order of their loading on the belt is, in such a way that the first to be sorted is by the side corresponding to its destination.

[0037] In this way each sorting unit will be able to sort two objects for each revolution of the sorting machine, so that the effective production will be equal to the double of the production expressed in cells per hour.

[0038] In reality an exactly double production will be obtained in the case of sorting machines with monolateral exits, that having exits placed only on one side of the sorting machine: in the case of machines with bilateral exits, the productivity will be a little smaller because some situations occur, in which the lower the frequence is the greater the number of destinations is, where only one of the objects loaded on the belt can be sorted because the other is directed to the opposite exit.

[0039] In the practical cases, the effects are negligible: it can be considered for example an application with 200 bilateral destinations, supposing that, because of the high speed of the machine, after the unloading of an object in a particular destination, it is not possible to unload the other object, which is on board of the same cell, in the opposite destination and in the following ones, the same opposed.

[0040] Supposing that, all the destinations equiprobable, given a pair of objects, the probability of having the previous condition and therefore that, only one can be sorted during the revolution of the machine, is equal to 3/200.

[0041] Therefore, considering the work of 10000 cells per hour, 150 cells (=10000 x 3/200) will sort only one of the two objects during every rotation of the machine, while the remaining 9850 will sort both the objects.

[0042] The total productivity will result equal to 19850 objects per hour, with a loss equal to 0.75%.

[0043] In practice, the loss will be more limited because not all of the destinations are equiprobable: it exist always a limited number of destinations, already known, collecting a great part of the flux; it will be sufficient therefore to distribute the important exits so that they result distant one to another in order to further reduce the probability that the condition above-mentioned occur.

[0044] The present invention will now be described in details, as a non limitative example, with reference to the enclosed figures.

- Figure 1 shows a sorting machine with cross belts:

it is comprises trucks that move on rails, which are connected one another by means of ties articulated in such a way to form a continuous train.

- Figure 2 shows a possible configuration of a loading station which is capable of loading pairs of objects on the same cell.
- Figures 3 to 3f show the time sequences of the two possible cases.
- Figures 4 to 4f show the successive time evolution: the two objects are sorted to the destinations during successive steps.
- Figure 5 shows in outline an equipment for the loading of objects in a sorting machine according to the invention.

[0045] With reference to figure 1, a machine with a belt unit sufficient for loading two objects moves at a constant speed along a closed route, driven by electrical motors arranged on board.

[0046] For example, the machine comprises a plurality of belt units 1, each comprising a truck 2 which moves along tracks 3.

[0047] On each truck a belt 4 is mounted, which is driven by a servomotor 5, on which are loaded, in pairs, the objects 6 and 7 to be sorted.

[0048] The belts are preferably actuated by means of servoamplifiers with speed feedlock, so that the activation can be very independent of the weight of the objects conveyed.

[0049] The control permits constant and limited accelerations, so that the sliding phenomena of the objects on the belt result negligible.

[0050] Thanks to these characteristics the control technic permits to obtain with precision and with repeatability the multiple belt shiftings which are necessary for the treatment of two objects, as requested by the present invention.

[0051] In the same way, the consolidated unloading technics of an object on board of a belt sorting unit, permitting a precise control of the final position of the object on board, offer the possibility that after the first loading, a second object is transferred on board in the same way, by means of a second loading unit.

[0052] The loading technics involve the use of belts, oriented at 45° with respect to the sorting machine, which are able to accelerate the object so that to obtain a synchronized loading on the belt cell, said loading being activated at the moment of the arrival of the object in such a way that the transfer of the object occurs without slidings.

[0053] As shown in figure 2, in a loading station which is capable to load pairs of objects on the same cell, the objects, provided with bar code, are identified by a reading station (8).

[0054] After having defined the destination of the pairs of objects, there last are part in these requested loading order, by shifting one or the other object on the upstream loading line, by means of a conveyor belt (9) which is capable of orthogonal mouvements.

[0055] Figure 3 shows the time sequences of the two possible cases, while figure 4 shows the following time evolution: the two objects are sorted to the destinations during successive steps.

[0056] Figures 3A to 3f show the example in which a parcel A must be loaded on the cell before a parcel B.

[0057] In case the parcel B arrives at the loading station before the parcel A (Figure 3a) the parcel B is advanced and successively the parcel A is deviated on the loading line sideways.

[0058] In case the parcel B arrives at the loading station after the parcel A (Figure 3b) the parcel A is deviated on the loading line sideways and successively the parcel B moves forward.

[0059] In both cases the situation schematized in figure 3 c, is reached, in which the parcel A is on the belt downstream and the parcel B on the one upstream.

[0060] After the loading action, the two parcels are arranged on the cell as schematized in figure 3 f.

[0061] When unloading two possible cases could becom: both parcels are unloaded at the same side of the machine or both parcels are unloaded at opposite sides.

[0062] In the first case if the parcel B is to be unloaded before the parcel A, the belt of the cell is activated to make the parcel B exit (Figure 4a) and the parcel A shifts, remaining however on the cell after that the parcel B has been unloaded (Figure 4b).

[0063] Even the parcel A, when it arrives near the corresponding exit, is unloaded by activating the belt of the cell in the same direction (Figure 4 c).

[0064] On the contrary, in case two parcels must be unloaded on opposite parts, the first to be activated is the belt in the unloading direction of the first of the two parcels (for example unloading of the parcel B in figure 4d), with the parcel A that shifts, remaining however on the cell.

[0065] The belt is activated in order to bring the parcel A back to the original position, successive to the loading, (Figure 4e) and thereafter, near the corresponding exit, also the parcel A is unloaded by activating the belt of the cell in the direction opposite to the previous one (Figure 4f).

[0066] The lateral deviation, which is necessary for automatically arranging the objects in the requested order, obtained by means of the conveyor (9) of figure 2, can be performed by means of orthogonal tables, that is with machines (which are known) capable of mouvements in the two orthogonal directions, comprising motorized rollers alterned with narrow conveyor belts which are raised beyond the rollers when the conveyance direction of the object is to be changed.

[0067] For the deviation it is possible to use also, in the applications with regular objects which can be easily treated, simple deviators in a fixed position after the reading station of the bar code.

[0068] In the more complicated cases, with objects which are more difficult to treat, it is possible to use ma-

chines deriving from sorting machines with pushing means, as shown in figure 5, in which one sorter element 10 pushes the objects towards one side or the other of a roller conveyor, in order to address the same towards separated conveyors which load them on the machine.

[0069] It is also possible to use manual solutions for the loading; in this case the operators will load pairs of objects on the loading belts, or directly on the cells, after having read the bar code of the objects with a laser gun and consequently having received from the computer the information concerning the order of the two objects.

[0070] In order to load pairs of ordered objects it is possible to take advantage of the possibility given by the multiple loading stations; in this case the stations could be the conventional belt stations, oriented at 45° with respect to the machine, arranged in sequence.

[0071] In this case, supposing that a station loads an object on one cell, there is a great probability that there is at least an object, available on the lines downstream of the previous one, which has a suitable destination to be loaded on the same cell.

[0072] This method is a probabilistic one, and therefore adequated safety margins must be considered on the value of the practical productivity, unlike the method before described, where the automatic order of each pair of objects is deterministic and therefore assures the double productivity.

[0073] Inspite of this, the probabilistic method could result economically interesting in particular applications, since it would permit an average productivity higher than 80% at least, with respect to the productivity of the machine, with cheap loading solutions.

[0074] The solution described for the treatment of pairs of objects on the same sorting unit, in order to double the productivity of the sorting machine, can be generalized to the cases of three or more objects on the same unit, in order to obtain higher capacities.

[0075] In these cases it is possible to foresee also a vertical arrangement of the objects, stacking upon the sorting cell in a different order with respect to the unloading priority.

[0076] For example, for applications with thin objects, i.e. books, envelopes, clothes, it is possible to consider that, the sorting belt unit, is fitted on its upper side with a suitable vertical loader, which is capable to load a number of objects in as many separated positions.

[0077] At each activation of the sorting belt, the loader would provide with the vertical conveyance of the end of the objects, making them shift down of a position and therefore feeding in sequence the belt of the cell which will sort all the objects.

[0078] A skilled man will be able then to foresee various changes and variations in order to obtain solutions with an elevated productivity, or to obtain the productivity requested by the sorting machine with a very low advancing speed.

[0079] The changes and variations will have to be however included in the field of the present invention.

Claims

1. Method for the sorting of objects by means of an equipment consisting in a plurality of conveyor platforms running along a route between an objects loading zone and an unloading zone in which the objects are unloaded into collecting devices situated sideways with respect to the route of the conveyor platforms and in which each of said conveyor platforms is fitted with means for unloading the conveyed objects sideways with respect to the machine, characterized by the fact that

   - the objects to be sorted are ordered in pairs so as to load them in the machine respecting the unloading order;
   - two objects are loaded on each conveyor platform;
   - the unloading of said objects is carried out according to the required order, when said conveyor platform runs near of the collecting devices designed for said objects.

2. Method for the sorting according to claim 1, characterized by the fact that:

   - each conveyor platform is divided, phisically or by software, in two zones both assigned to receive an object to be sorted;
   - at loading, it is determined, for each pair of objects, the order in which they must be unloaded;
   - the objects are loaded into the machine so that, after the loading, to first object to be unloaded is in the zone of the conveyor platform arranged on the side where there is the first unloading station.

3. Method for the sorting of objects according to claim 2, characterized by the fact that at loading, the objects are ordered in pairs and are put into the machine so that the objects of each pair respect the unloading order.

4. Method for the sorting of objects by means of an equipment consisting of a plurality of conveyors running along a route that comprises a loading zone in which the objects to be sorted are placed on said platforms and an unloading zone in which the objects are unloaded into a plurality of collecting devices, and in which each conveyor platform is fitted with means for the sideway unloading of objects, characterized by the fact that:

   - each conveyor platform is divided, phisically or by software, in two zones both assigned to receive an object to be sorted;
   - the objects to be loaded into the machine are ordered in pairs and for each pair it is deter-

mined which one of the two objects must be first unloaded;

- the objects are loaded into the machine so that, after the loading, the object which is the first to be unloaded is in the zone of the conveyor platform which near the side where there is the first unloading station.

5. Method according to claim 4, characterized by the fact that:

- for each pair of objects, the order in which these ones arrive to the loading devices is checked;
- it is determined, on the basis of the unloading destination of each object, which place this one must have on the conveyor platform;

if necessary, the order of the objects is reversed, before the introduction in the machine, so that the first object to be unloaded is placed in the zone of the conveyor platform which, after loading, is nearest to the unloading side.

6. Equipment for the sorting of objects, with high productivity, of the type comprising a plurality of conveyor platforms movable between a loading zone in which said objects are introduced in the machine and an unloading zone in which the objects are unloaded into a plurality of containers placed sideways with respect to the route, characterized by the fact that each conveyor platform is divided, phisically or by software, in two zones, both designed to receive an object, means being provided designed to modify the loading order of the objects in the machine, so that the first object to be unloaded is placed in the zone of the conveyor platform which, after loading, is the nearest to the unloading side.

7. Equipment according to claim 6, in which the objects are put into the machine by means of rotating belts that put the objects on the conveyor platforms when they run near the loading zone, characterized by the fact of providing at least a segment in which said loading rotating belts are splitted, being provided, upstream of said splitted platform exchanger devices designed to address the incoming objects towards the one or the other branch of said splitted belt.

8. Equipment according to claim 7, characterized by the fact that said exchangar devices are an orthogonal table.

9. Equipment according to claim 6 or 7, characterized by the fact that it is provided, near of the loading station, a pair of superplaced belts mounted on a support able to raise and lower the whole in order to aligne said belts with the loading belt in the machine and the conveyor platforms.

10. Sorting equipment as described and shown.

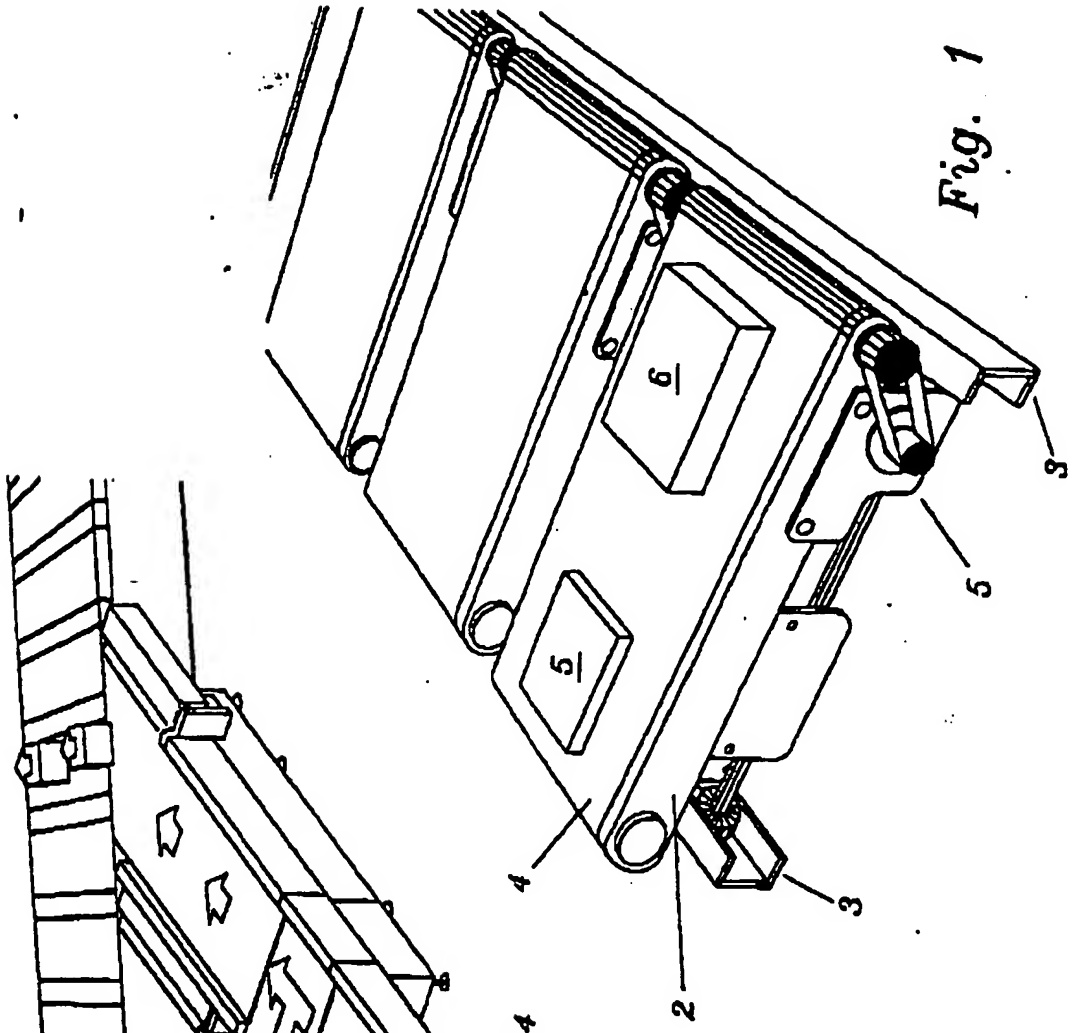


Fig. 1

Fig. 2

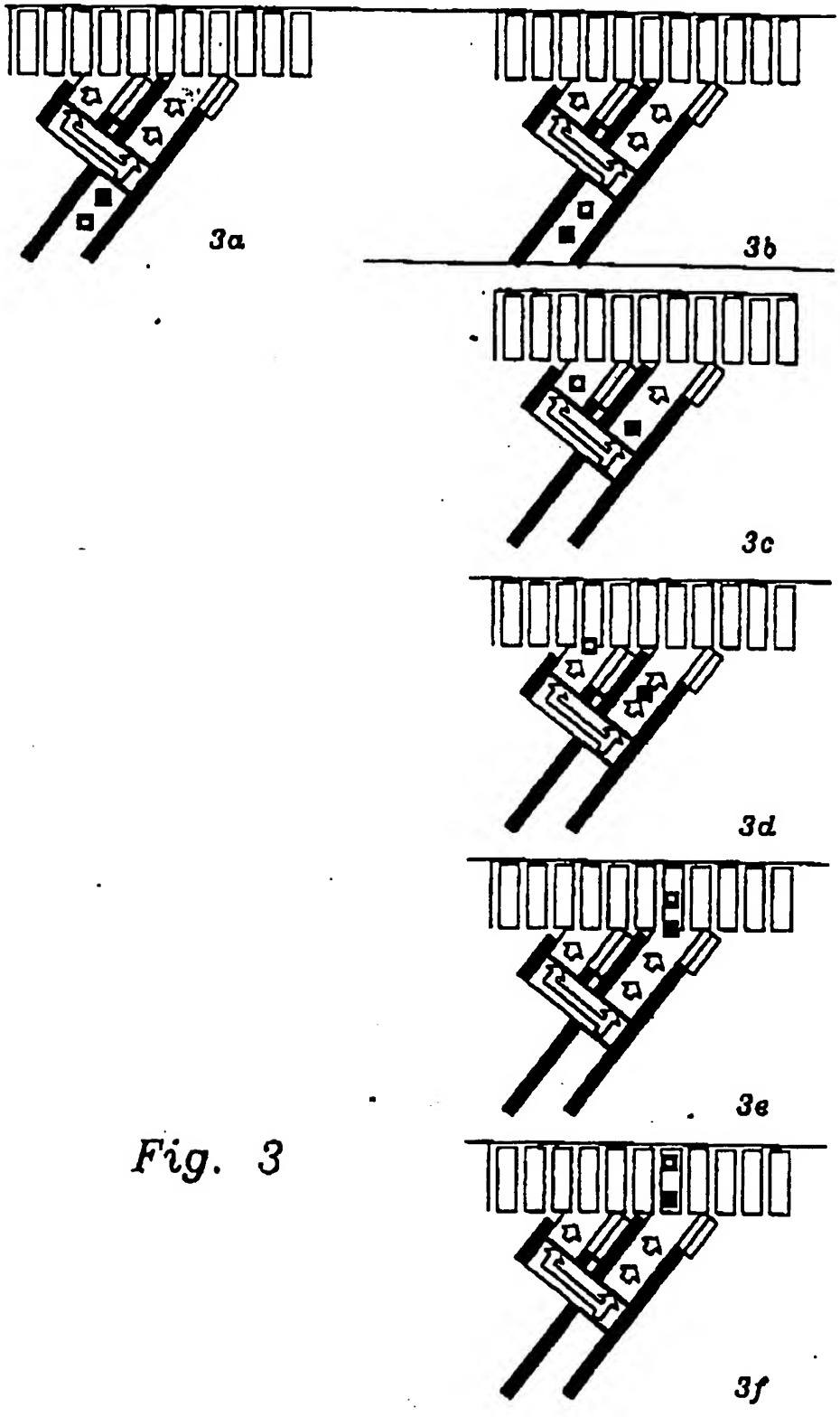
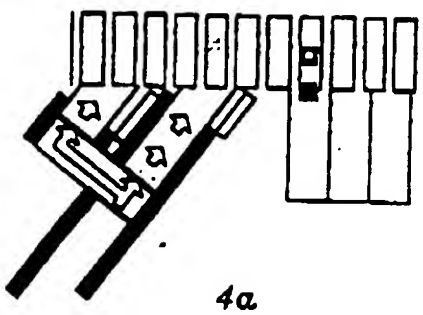


Fig. 3



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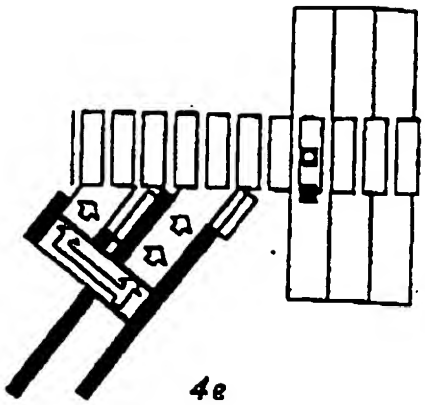
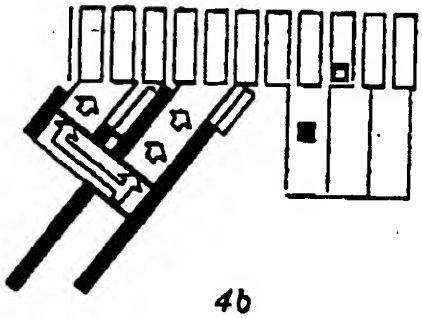
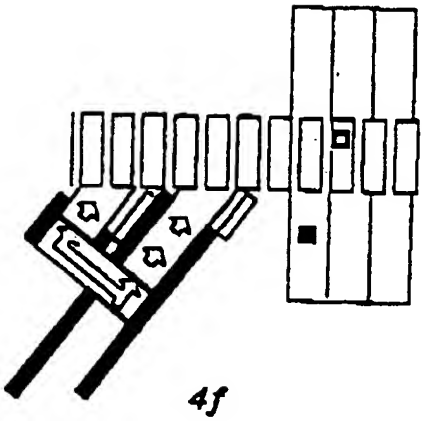


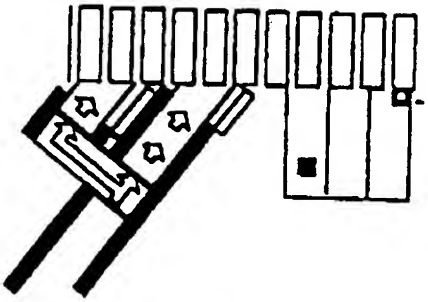
4e



4b



4f



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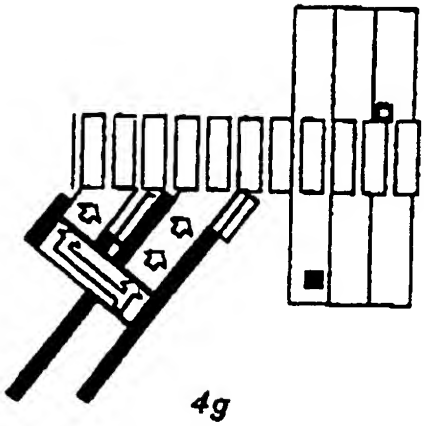

4g

Fig. 4

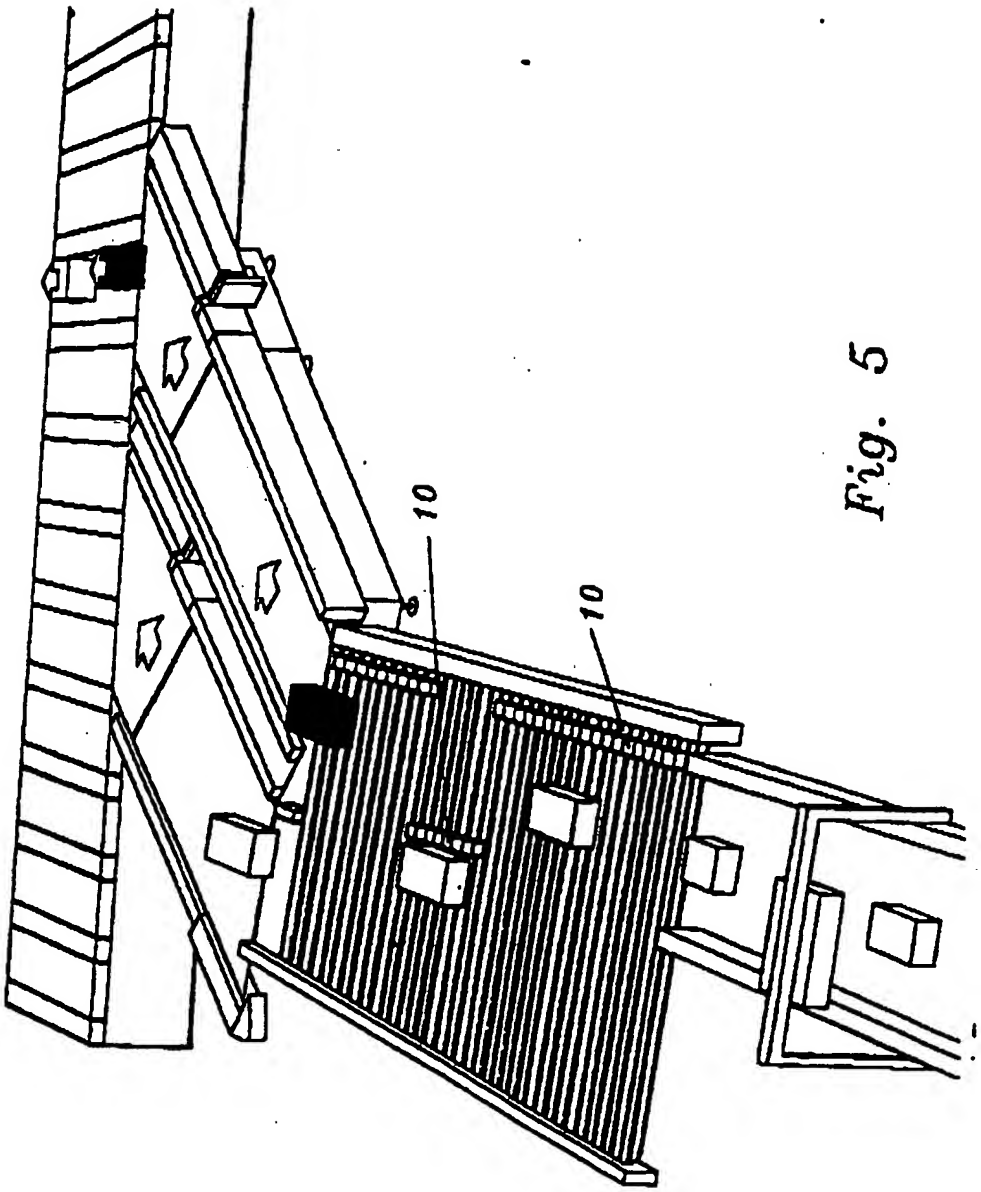

Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 85 0176

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 633 208 A (TOYO KANETSU KK) 11 January 1995 * the whole document *	1-9	B65G17/34 B65G47/71
A	EP 0 774 429 A (SANDVIK AB) 21 May 1997 * the whole document *	1-9	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B65G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 April 1999	Ostyn, T

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08-04-1999

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82